STAFF REPORT

Insecticide Use on Cotton in the United States--1969, 1972, and 1974

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Fred T. Cooke, Jr.
and
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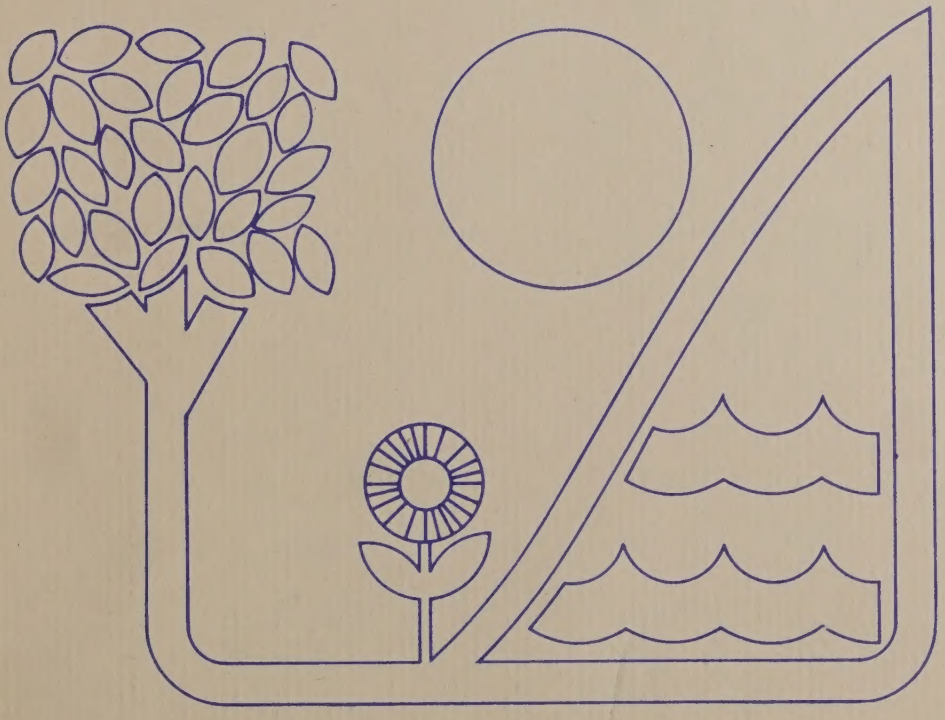
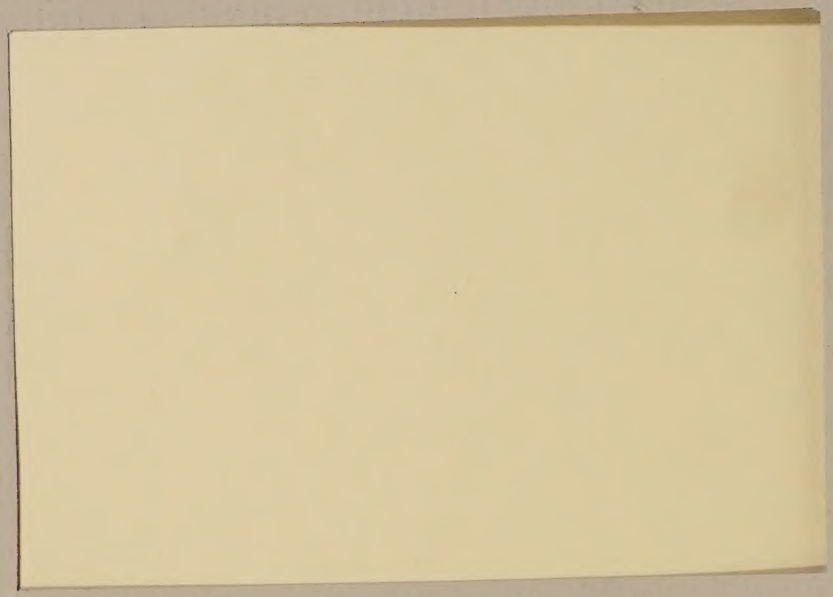
April 1981

NRE
Economics and Statistics Service
United States Department of Agriculture





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ABSTRACT

There were dramatic increases in cost of insect control from 1969 to 1974. The large increase in the usage of toxaphene and methyl parathion between 1972 and 1974 reflect the impact of banning DDT. A mixture of these two insecticides was the best alternative mixtures using DDT.

This information was obtained from the national cotton cost surveys conducted in 1969, 1972 and 1974 and supplemented by data for various subregions of the cotton belt. Data on cost and quantities of specific major insecticides used on cotton is reported for the entire belt. Data on acres treated, cost per acre, and average number of applications per treated acre are included.

Key words: Cotton; insecticides; costs; pounds of materials; number of applications.

CONTENTS

Introduction

Increased concern with alternative cotton insect management strategies has highlighted the need for historical data on insecticide use on cotton. Available data on insecticide use over time is fragmented and often does not provide satisfactory information for economic analysis. While this report identifies some problems with completeness of data, survey designs, and intended survey use, information will be useful to those who need as complete a data base as possible on insecticide use on cotton.

Methodology

Insect control has long been a necessary part of cotton production in the United States. The number of insect pests identified as having an economic effect on cotton production has continued to grow. Some insects have developed resistance to particular insecticides resulting in producers switching to more expensive insecticides or combinations of insecticides. Quantities of insecticides used in cotton production steadily increased until 1977 when the impact of new extension pest management practices and the introduction of synthetic pyrethroids with their lower recommended application rates began to reverse this trend as indicated by preliminary results of a 1979 survey of pesticide use in cotton production.

Insect control data from the 1969, 1972, and 1974 cotton cost surveys were used as a basis for this analysis [1,2,3]. Data from these surveys on kinds and quantities of insecticides used by cotton producers were not available or complete. However, the surveys did provide useful

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BACKGROUND

Insect control has long been a necessary part of cotton production in the United States. The number of insect pests identified as having an economic effect on cotton production has continued to grow. Some insects have developed [illegible] to particular insecticides resulting in producers switching to more expensive insecticides or combinations of insecticides. Quantities of insecticides used in cotton production steadily increased until 1971 when the impact of new integrated pest management practices and the introduction of synthetic pyrethroids with their lower recommended application rates began to reverse this trend as indicated by preliminary results of a [illegible] survey on pesticide use in cotton production.

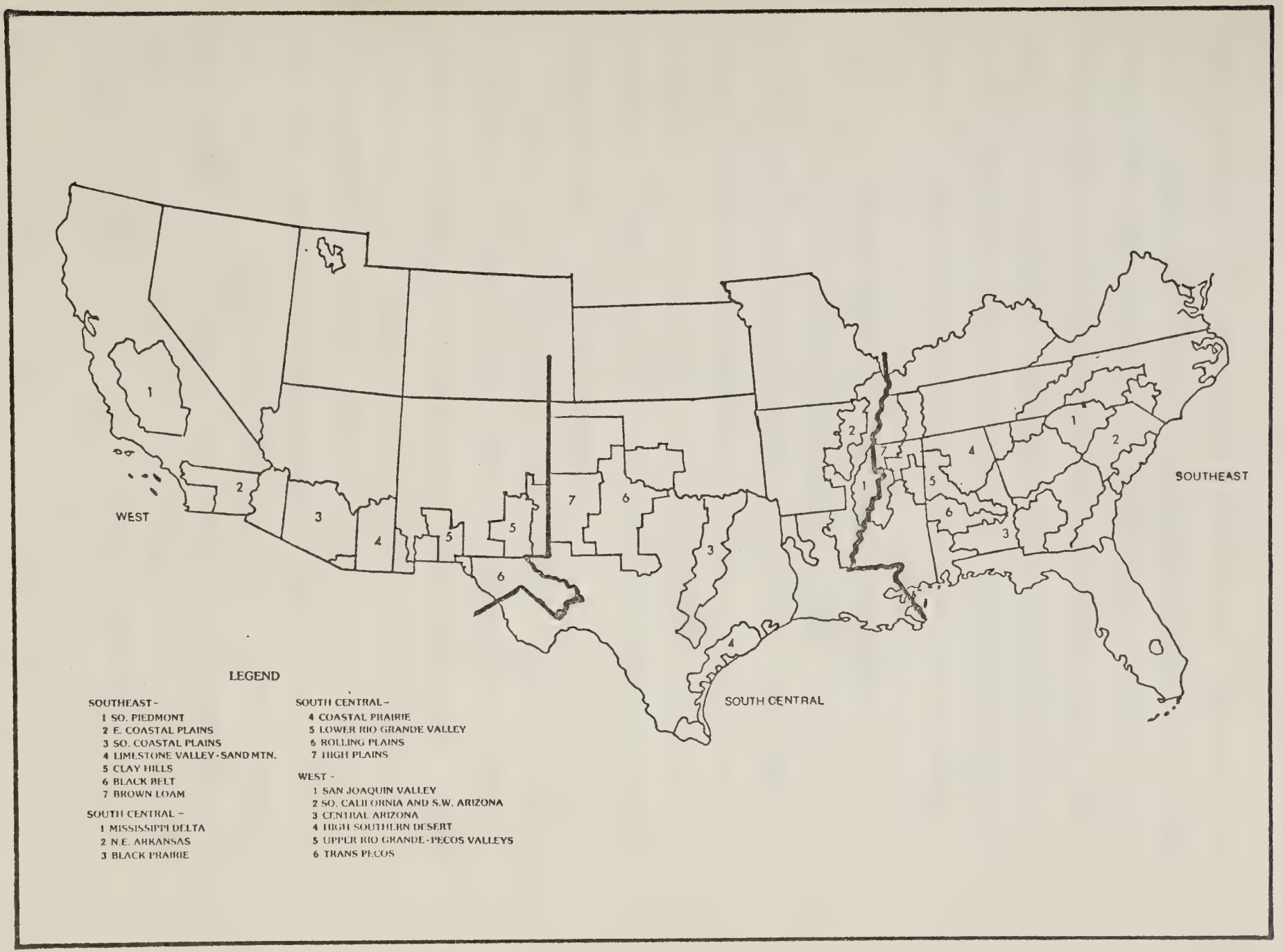
Insect control data from the 1964, 1971, and 1976 surveys were used as a basis for this analysis (1,2,3). Data from these surveys on kinds and quantities of insecticides used by cotton producers were not available at [illegible]. However, the surveys did provide useful

information on number of applications and total cost per acre for all insecticides.

Data were available for most of the cotton production regions used in the cotton cost surveys (see figure 1). These production regions will be referred to as sub-regions in this report. To supplement cotton cost survey data, information was obtained from knowledgeable cotton entomologists in each of these sub-regions, information was obtained on average number of applications of insecticides by major pests, type of material used, rates of application, and cost. At the sub-region level, this information was adjusted to approximate the number of applications and average costs per acre for all insecticides as derived from cotton cost survey data. The adjustment technique did not have sufficient detail to permit extreme reliance on the specific quantities of materials reported here, i.e. the use of major insecticides is overstated while the use of minor insecticides is biased downward. However, the information is of value in indicating the insecticides commonly used in cotton production. The method of analysis permitted the inclusion of a specific insecticide only if it was heavily utilized in a given year. Consequently, materials may be reported being used in one year and not in another. Thus it is not implied that a material was not used, but that reported use was too low to provide reliable estimates of total use.

Expenditures for insecticides vary from year to year. Weather during the winter has a significant impact on the number of specific insects that will emerge in the spring. Similarly weather during the growing season will affect the population dynamics of a specific insect.

Figure 1. Production Regions for Cotton Cost Surveys



Most insects that attack cotton have alternative host plants, both agricultural and wild, which can affect population dynamics. All of these factors affect infestation levels of insects and the duration of the infestation that are the principal factors in insecticide use. No useful data on infestation levels and their duration was found that could be related to the data presented here. Without this information, analysis of trends in insecticide use over time could be misleading.

Data Deficiencies, Limitations, and Problems

The cotton cost surveys were designed to estimate the cost of producing cotton and were not designed for purposes of this study. Certain deficiencies, limitations, and problems were encountered in analyzing the cotton cost survey data in this study. These may be classified as related to: (1) survey design, (2) questionnaire design and enumeration, and (3) data processing.

Pesticide use surveys conducted by the USDA in 1964, 1966, 1971, and 1976 were national in scope. While the national cotton pesticide estimates provided in these studies are probably satisfactory, regional, state, and sub-state estimates in many instances cannot be considered reliable because of the small number of cotton farmers interviewed. There are no expenditure estimates provided in the 1976 national pesticide use survey. The surveys on which this report is based obtained data from 4,200, 1,876, and 788 cotton farmers in the United States for 1969, 1972, and 1974, respectively. Additionally, this study provides information on insect control cost and number of applications per acre.

Survey design differences such as the progressive reduction in geographic coverage and decreasing number of cotton farms sampled posed major problems in comparing 1969, 1972, and 1974 survey data. Sub-regions SE-1, SE-6, W-4, and W-6 were surveyed in 1969, but not surveyed in 1972 and 1974 (see figure 1). Sub-region W-5 was surveyed in 1969 and 1972 but not in 1974. The proportions of U.S. upland cotton acreage planted represented by data from the surveys decreased from 89 percent in 1969 to 85 percent in 1972 and to 65 percent in 1974. Corresponding proportions of U.S. upland cotton production represented by surveyed farms was about 95 percent in 1969 and 1972 but only 56 percent in 1974.

The number of farmers providing usable data records declined from 4,200 in 1969 to 1,878 in 1972 and 899 in 1974. Although the lack of beltwide data had been recognized when planning this study, subsequent comparisons of 1972 and 1974 sub-regional data for insecticides revealed greater than expected variations which were probably the result of greatly reduced sampling rates. Because the reliability of sub-regional data are questionable, this paper presents sub-regional data in the Appendix without analysis. Such information will be most useful when pooled with similar data over a long period of time.

Cotton cost questionnaires and background enumerator study manuals provided inadequate instruction concerning how to report data for different insecticides purchased and/or applied as mixtures that resulted in incomplete reporting of insecticides. The extent of this under reporting is unknown and cannot be determined.

Severe use limitation of the data from cotton cost surveys results because individual insecticides were coded to facilitate specific data retrieval. Thus it was not possible to identify specific insecticides and the corresponding data on acres treated, application rate per acre, and per acre material cost. However, the cotton cost surveys do provide aggregate data on total cost per acre for all insecticides and related applications.

To identify specific insecticides and to obtain some feeling of the acres treated, application rates, and materials costs, state and local extension entomologists supplied estimates of the relative usage and cost of major insecticides for controlling predominate insects on cotton. Their estimates for these major insecticides were adjusted to the aggregate use and agree with the regional data provided by the cotton cost surveys. This approach is incorporated in tables 1 and 2 and Appendix tables 1 through 6. Ignored is usage of insecticides in controlling minor problem insects. To the extent that "minor" insecticides are included in cotton cost survey data, while being ignored in these tables, relative usage and costs of major insecticides are overstated.

Results

The principal insects attacking cotton in the United States are the boll weevil, bollworm, tobacco budworm, thrips, aphids, and lygus bugs. The relative importance of a specific insect will be different in various sub-regions in a given year and different in a given sub-region from year to year.

Table 1--Cost and quantities of principal insecticides used in major cotton producing regions in the United States, 1969, 1972, and 1974

Year/area	Total planted acres	Total cost of insecticides	Toxaphene	DDT	Methyl parathion	Guthion	Endrin	EPN	Bidrin	Kelthane	Azodrin	Comite
	1,000 acres	1,000 dollars	1,000 pounds									
1969												
Total of regions surveyed in all years 1/	10,107.7	39,045	32,433	15,926	15,540	--	--	--	447	610	254	--
Total of other regions 2/	558.3	3,497	2,679	1,166	1,487	--	--	--	--	--	--	--
Total all regions 1/	10,666.0	42,542	35,112	17,092	17,027	--	--	--	447	610	320	--
1972												
Total of regions surveyed in all years 1/	12,281.7	87,560	47,727	31,439	30,844	1,617	2,527	1,522	300	1,188	774	--
Total of other regions 3/	84.3	241	56	--	84	--	--	--	--	--	9	--
Total all regions	12,366.0	87,801	47,783	31,439	30,928	1,617	2,527	1,522	300	1,188	783	--
1974												
Total all regions 1/	12,248.0	123,651	82,244	--	48,923	539	--	--	--	--	542	2,275

1/ Sub-regions SE-2, SE-3, SE-4, SE-5, SE-7, SC-1, SC-2, SC-3, SC-4, SC-5, SC-6, SC-7, W-1, W-2, and W-3.
2/ Sub-regions SE-1, SE-6, W-4, W-5, and W-6.
3/ Sub-region W-5.

Table 2--Percent of planted acres treated with insecticides, cost per acre treated, and average number of applications for the United States for 1969, 1972, and 1974

Year	Planted acres	Percent planted acres treated	Acres treated	Cost per acre treated	Average number applications per treated acre
	1,000 acres	Percent	1,000 acres	Dollars	Number
1969	10,666	60	6,459	6.59	4.1
1972	12,366	60	7,705	11.40	6.1
1974	12,248	60	7,813	15.83	6.5

Table 1 presents the costs and quantities of the principal insecticides used on cotton in the survey area for each of the survey years. The technique used to derive these figures probably overstates usage of principal insecticides and excludes usage and corresponding expenditures for "minor" insecticides. From 1969 to 1972 quantities of materials used increased 81 percent and expenditures were up 124 percent, yet acreage increased only 21.5 percent.

The reasons for these increases cannot be accurately specified from these data but certain factors have certainly contributed to them. By the early 1970's, the boll weevil had developed genetic resistance to DDT wherever this insect was found. Greater use of toxaphene and methyl parathion was made to control this insect. Also, the problem of the cotton bollworm and tobacco budworm was increasing and becoming more widespread. The use of toxaphene and methyl parathion was greatly increased by 1974 for several reasons. During this period because of insect resistance there was a trend of reduced use of DDT and then the use of DDT was banned. A mixture of these two insecticides was a viable alternative to the mixtures which contained DDT as well as these two insecticides. Also, higher rates of the mixtures excluding DDT were required for control. A second factor affecting the use of toxaphene in 1974 was the shortage of methyl parathion. Methyl parathion generally was not available in 1974 except in mixtures with toxaphene. This resulted in producers using mixtures when they may have preferred to use methyl parathion alone. This significantly increased the pounds of active ingredients used and costs associated with the use of insecticides.

Also, price increases for many agricultural inputs including insecticides occurred in 1974 resulting in increased expenditures for insect control.

The increased use of insecticides and the pass-through to consumers of higher costs for these materials, following the end of price controls in 1973, contributed to a $9.24 increase in insecticide costs per treated acre between 1969 and 1974 (see table 2). A more detailed analysis of these increases cannot be made because the infestation levels of target insects are unknown.

Table 2 presents data on the acreage of cotton treated with insecticides, the cost per acre treated and the number of applications per acre. Again, we see the increase in per acre insecticide costs over time of $6.59 per treated acre in 1967, $11.40 per acre in 1972, and $15.83 per acre treated in 1974. The average number of applications increased in a similar manner over the three study years. The increase in number of applications may have been due to the increase in the severity of the bollworm and budworm problem or an efficacy problem with the insecticides used.

Appendix tables 1 through 4 present the quantities and expenditures for specific insecticides by sub-regions for each survey year. It should be noted that the sub-regions SE-2 through SE-7 and SC-1 through SC-5 account for a large portion of insecticide use in the Cotton Belt. Again, it must be emphasized that the specific data for each region is likely less reliable than the national data. However, these data do point out the relative importance of insecticides among the various sub-regions.

Appendix tables 5, 6, and 7 present regional data on acres of cotton treated with insecticides and number of applications per acre. These data have the same limitations as other regional data in this report, but would be useful for comparing relative importance of these items between and among regions.

Conclusions

Although the reliability of the specific quantities and costs of insecticides reported in this study is open to question, the study provides some insight into the relative quantities of insecticides used and relative importance of cotton insecticides among the major cotton producing regions. However, care must be exercised in using these numbers because of limitations in the survey data.

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Appendix table 1--Total expenditures for specified insecticides used for producing cotton by sub-region in the United States, 1969, 1972, and 1974

Sub-region	Total cost of insecticides		
	1969	1972	1974
	1,000 dollars		
SE 2	4,189	12,051	17,216
SE 3	2,768	5,919	9,396
SE 4	1,502	3,350	4,944
SE 5	1,861	1,989	3,908
SE 7	1,939	2,590	5,076
SC 1	13,062	28,852	38,738
SC 2	887	1,840	3,979
SC 3	1,385	2,221	3,844
SC 4	860	3,094	2,780
SC 5	1,979	5,502	9,703
SC 6	1,513	934	1,814
SC 7	626	1,695	1,110
W 1	2,872	7,825	9,385
W 2	1,411	2,995	3,917
W 3	2,191	6,703	7,841
Subtotal	39,045	87,560	123,651
SE 1	1,085	--	--
SE 6	1,312	--	--
W 4	71	--	--
W 5	684	241	--
W 6	345	--	--
Subtotal	3,497	241	--
Total	42,542	87,801	123,651

Appendix table 2--Pounds of technical insecticides used by sub-region in the United States, 1969 1/

Sub-region	Toxaphene	DDT	Methyl parathion	Bidrin	Kelthane	Azodrin
	1,000 pounds					
SE 2	5,926	2,043	3,065	--	--	--
SE 3	4,243	2,121	1,020	--	--	--
SE 4	1,788	645	447	--	--	--
SE 5	650	1,300	650	--	--	--
SE 7	868	414	827	--	--	--
SC 1	13,536	6,768	6,768	338	--	--
SC 2	455	455	227	46	--	--
SC 3	775	388	129	--	--	--
SC 4	394	473	--	63	--	--
SC 5	2,283	--	761	--	--	--
SC 6	--	--	1,157	--	--	--
SC 7	652	--	489	--	--	--
W 1	--	915	--	--	610	--
W 2	347	198	--	--	--	124
W 3	516	206	--	--	--	130
Subtotal	32,433	15,926	15,540	447	610	254
SE 1	1,356	678	432	--	--	--
SE 6	616	460	616	--	--	--
W 4	48	28	--	--	--	--
W 5	517	--	345	--	--	36
W 6	142	--	94	--	--	30
Subtotal	2,679	1,166	1,487	--	--	66
Total	35,112	17,092	17,027	447	610	320

1/ Not all of the specified materials are included in this table. Materials are only included if a sufficient quantity was used in an area to provide a reliable level of accuracy.

Appendix table 3--Pounds of technical insecticides used by sub-region in the United States, 1972 1/

Sub-region	Toxaphene	DDT	Methyl parathion	Guthion	Endrin	EPN	Bidrin	Kelthane	Azodrin
	1,000 pounds								
SE 2	8,362	5,932	2,768	--	--	--	--	--	--
SE 3	6,354	3,177	836	418	1,254	752	--	--	--
SE 4	3,150	1,610	805	385	595	770	--	--	--
SE 5	3,485	1,742	1,742	242	678	--	--	--	--
SE 7	4,378	2,189	1,074	--	--	--	--	--	--
SC 1	15,624	15,624	15,624	--	--	--	260	--	--
SC 2	1,197	798	399	--	--	--	40	--	--
SC 3	1,100	367	550	--	--	--	--	--	--
SC 4	572	--	1,144	572	--	--	--	--	--
SC 5	1,505	--	3,612	--	--	--	--	--	--
SC 6	--	--	784	--	--	--	--	--	--
SC 7	648	--	810	--	--	--	--	--	--
W 1	--	--	--	--	--	--	--	1,188	--
W 2	273	--	156	--	--	--	--	--	234
W 3	1,079	--	540	--	--	--	--	--	540
Subtotal	47,727	31,439	30,844	1,617	2,527	1,522	300	1,188	774
W 5	56	--	84	--	--	--	--	--	9
Total	47,783	31,439	30,928	1,617	2,527	1,522	300	1,188	783

1/ Not all of the specified materials are included in this table. Materials are only included if a sufficient quantity was used in an area to provide a reliable level of accuracy.

Appendix table 4--Pounds of technical insecticides used by sub-region in the United States, 1974 1/

Sub-region	Toxaphene	Methyl parathion	Guthion	Comite	Azodrin
	1,000 pounds				
SE 2	11,856	6,916	--	--	--
SE 3	5,705	2,852	--	--	--
SE 4	5,869	2,934	--	--	--
SE 5	4,053	2,026	--	--	--
SE 7	3,233	1,616	539	--	--
SC 1	37,382	18,691	--	--	--
SC 2	3,128	1,390	--	--	--
SC 3	--	2,755	--	--	--
SC 4	6,177	1,235	--	--	--
SC 5	--	4,475	--	--	--
SC 6	613	1,430	--	--	--
SC 7	317	476	--	--	--
W 1	--	--	--	2,275	--
W 2	529	282	--	--	234
W 3	3,382	1,845	--	--	308
Total	82,244	48,923	539	2,275	542

1/ Not all of the specified materials are included in this table. Materials are only included if a sufficient quantity was used in an area to provide a reliable level of accuracy.

Appendix table 5--Percent of planted acres treated with insecticides, cost per acre treated, and average number of applications by sub-region in the United States, 1969

Sub-region	Planted acres	Percent planted acres treated	Acres treated	Cost per acre treated	Average number applications per treated acre
	1,000 acres	Percent	1,000 acres	Dollars	Number
SE 1	161	96	154	7.04	4.4
SE 2	529	96	510	8.20	6.8
SE 3	213	95	203	13.57	10.4
SE 4	318	78	248	6.05	3.6
SE 5	242	89	216	8.59	7.9
SE 6	159	97	154	8.52	5.9
SE 7	595	69	413	4.69	3.9
SC 1	1,920	88	1,691	7.72	4.1
SC 2	407	56	227	3.90	2.8
SC 3	806	64	516	2.68	2.1
SC 4	354	89	315	2.73	1.8
SC 5	311	81	253	7.80	6.0
SC 6	1,406	14	192	7.85	4.9
SC 7	2,064	16	326	1.92	1.2
W 1	643	95	609	4.71	1.5
W 2	100	99	99	14.24	6.7
W 3	218	94	206	10.62	4.4
W 4	38	34	13	5.19	1.9
W 5	65	88	57	11.91	8.6
W 6	108	44	47	7.30	3.0

Appendix table 6--Percent of planted acres treated with insecticides, cost per acre treated, and average number of applications by sub-region in the United States, 1972

Sub-region	Planted acres	Percent planted acres treated	Acres treated	Cost per acre treated	Average number applications per treated acre
	1,000 acres	Percent	1,000 acres	Dollars	Number
SE 2	581	97	565	21.33	12.9
SE 3	215	97	209	28.32	15.2
SE 4	392	89	350	9.57	4.6
SE 5	277	87	242	8.22	7.2
SE 7	766	54	413	6.27	5.3
SE 1	2,858	91	2,604	11.08	7.1
SC 2	552	72	399	4.61	4.0
SC 3	799	92	733	3.03	2.2
SC 4	306	93	286	10.82	4.5
SC 5	320	94	301	18.28	8.9
SC 6	1,558	11	165	5.66	3.2
SC 7	2,534	13	324	5.23	1.5
W 1	821	96	792	9.88	1.5
W 2	80	98	78	38.40	9.2
W 3	215	100	216	31.06	9.2
W 5	84	33	28	8.62	2.9

Appendix table 7--Percent of planted acres treated with insecticides, cost per acre treated, and average number of applications by sub-region in the United States, 1974

Sub-region	Planted acres	Percent planted acres treated	Acres treated	Cost per acre treated	Average number applications per treated acre
	1,000 acres	Percent	1,000 acres	Dollars	Number
SE 2	494	100	494	34.85	14.0
SE 3	205	100	205	45.79	13.9
SE 4	376	97	366	13.48	8.1
SE 5	254	99	253	15.43	8.3
SE 7	849	63	538	9.42	7.4
SC 1	2,581	91	2,336	16.58	7.4
SC 2	477	73	347	11.45	4.8
SC 3	731	86	626	6.14	4.4
SC 4	219	94	205	13.50	4.3
SC 5	340	97	331	29.27	9.8
SC 6	1,547	13	204	8.88	5.3
SC 7	2,558	12	317	3.50	1.5
W 1	1,163	98	1,137	8.25	1.5
W 2	141	100	141	27.78	6.8
W 3	307	100	307	25.50	7.2